Periodic Reporting for period 1 - GeHa (Gemination Harmony)

Reporting period: 2015-09-01 to 2017-08-31

Summary of the context and overall objectives of the project

Research on speech has so far mainly dealt with how a sound in a given word is influenced by a neighbour sound (referred to as coarticulation). For instance, in the English word ‘shoot’, the rounded vowel ‘u’ is anticipated by rounding the lips on the sound ‘sh’.

Far less explored are those cases of coarticulation that occur at distance, that is, from a certain sound to another one that is non adjacent to it. This phenomenon is more commonly referred as ‘harmony’ in phonology.

The current project has investigated if non-local adjustments between sounds occur in words that differ at a temporal level. In particular, it has determined whether the initial consonant /p/ is temporally influenced by the durational differences of the medial consonant /l/ in word pairs such as the Italian ‘palla’ vs. ‘pala’. The prediction is that the /p/ is longer when followed by a long /l/ than a short one (/p/ is longer in palla than in pala). The lengthening of the word-initial consonant helps speakers to enhance the upcoming durational contrast. Anticipation in speech planning is a phenomenon of high interest for articulatory models of speech production. It is also matter of debate for cognition. During the two-year fellowship, the researcher has also tried to determine how well in advance listeners use fine-grained speech cues (in this case, the lengthening of the word-initial consonant of the geminate word, cf. above) to spoken word recognition. Hence, the main question of the current project has been to determine whether anticipatory non-local adjustments can additionally be caused by prosody-based contrasts (and not only, by feature-based contrasts) such as the durational properties of a sound in production and comprehension.

Studying the non-local adjustments determined by prosody-based contrast can deepen our understanding on the relation between phonetics and phonology, that is between the continuous properties of the speech sounds and their cognitive representation as abstract and categorical units. Knowing the physical property of speech sounds and its abstraction is crucial for our understanding of the core mechanisms underlying the human faculty of speech communication.

The current project has achieved three important scientific objectives.

The first objective has been to show that adjustments between non-adjacent segments in a word are not only caused by feature-based contrast (as in the case of vowel-to-vowel coarticulation or nasalization) but also by prosody-like contrasts, such as the temporal properties of a sound (as in gemination).

The second important objective has been to reply to the question of why length contrast is prevalently binary across world languages, compared to other types of contrasts such as tone or height.

The third objective has been to understand whether and, if so, how far non-local adjustments interact with prosodic-related factors (such as boundary strength) and performance-related factors (speech style differences between journalistic and casual speech).
Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The first study investigates non-local temporal adjustments before an upcoming length contrast in Italian and in Japanese minimal pairs that differ only in the length of the medial consonant (e.g., geminate word 'palla' meaning 'ball' vs. the non-geminate word 'pala' - 'shovel').

Results show that:
- The duration adjustment extends further to the word-initial consonant, e.g., the [p] in palla is significantly longer than that in pala.
- This lengthening is unique to geminates (cluster do not have such lengthening).

These results have been for instance published in:


The second set of studies (see references 2/3 below) replies to the question of why binary contrast is prevalently binary in world’s languages.

This question has been addressed by looking at poorly investigated languages such as Moroccan Arabic.

Main results show that in production speakers have a clear preference for a binary length contrast: Because it involves too much crowding in the consonant duration space, it is expected that no language may have a four-level length contrast.

3. Turco, G. Ridouane, R. (in prep.) Why is length contrast prevalently binary?]

The third set of studies focuses on factors that have an impact on the production of vowel-to-vowel coarticulation (also ‘vowel height harmony’) in French.

Main results show that:
- French vowel-to-vowel coarticulation is affected by prosodic position: the stronger the prosodic position, the less coarticulation there is between the two non-adjacent vowels.
- Speech style differences are found to have a more subtle effect on vowel-to-vowel coarticulation that the one described in the literature.


Another set of studies has focused on anticipation in speech planning and processing based on other acoustic cues of speech - namely, pitch - besides duration.

The main results of these studies suggest that language users can rely on those cues to anticipate their message content and to process upcoming information in speech.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Most of the previous research has focused on coarticulation as driven by feature-based contrasts as in nasalization (e.g. the feature [nasal]) reflecting the basic defining articulatory properties of a segment (e.g. the anticipation of the opening of the velopharyngeal port for [nasal] harmony triggered by a [+nasal] consonant), the main contribution of the current project is to have shed light on those types of adjustments caused by prosody-like phenomena, such as the temporal properties of a sound. This contribution is crucial for our understanding of the relation between phonetic and phonology.

The work performed during the two-year research fellowship has been well welcomed by the research community, as witnessed by the strong dissemination activity performed by the researcher during the fellowship. The researcher has participated to highly selective conferences, published in top international journals and proceedings, set up several collaborations. Moreover, the results gained during the two-year fellowship have also had a strong impact on the researcher’s career (she is now a permanent CNRS researcher).

Related information

![geha-spectrogram-example-image.png](geha-spectrogram-example-image.png) ![geha-eye-tracking-example-image.png](geha-eye-tracking-example-image.png)

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